

11/045/017

BARRICK

BARRICK RESOURCES (USA), INC.

October 2, 1992

Mr. Don A. Ostler, P.E.
Director
Division of Water Quality
Utah Department of Environmental Quality
P.O. Box 144870
Salt Lake City, Utah 84114-4870

Dear Mr. Ostler:

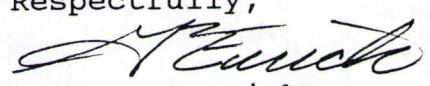
Subject: Valley Fill Leach Area 2

Pursuant to our meeting of July 16, 1992, please find attached a report prepared by JBR Consultants Group entitled "Valley Fill Leach Area 2 Soil Moisture Balance." The report evaluates the potential for infiltration through Area 2 to waters of the state after closure.

Worst case assumptions were made to ascertain ultimate infiltration potential. As indicated on page 3, paragraph 2 of the report, no threat to public health or the environment will occur under the closure procedures proposed in our July 10, 1992 plan.

We would suggest a meeting with you and your staff to discuss this report and the Division's list of outstanding issues referenced in your letter dated August 3, 1992. Please contact me to schedule such a meeting or with any questions you may have concerning this correspondence.

Respectfully,



Glenn M. Eurick
Environmental Affairs Coordinator (USA)

GME/cg
Attachment

- cc: C. Landa
D. Bird (Parsons Behle & Latimer)
B. Buck (JBR)
F. Nelson (Utah Attorney General Office)
W. Hedberg (DOGM)
G. Shelley (Utah County)
M. Bateman (Tooele County)
D. Beatty
C. Olsen
R. Sacrison



CONSULTANTS GROUP

GEOLOGY

ENGINEERING

ENVIRONMENT

HYDROLOGY

September 8, 1992

Mr. Glenn Eurick
Barrick Mercur Gold Mine
P.O. Box 838
Tooele, Utah 84074

RE: Valley Fill Leach Area 2 Soil Moisture Balance

Dear Glenn:

At your request, we have conducted an evaluation of the soil moisture balance for the reclaimed Area 2 valley fill Leach. The water balance was evaluated using the methods described in Thornwaite and Mather (1957) to estimate the amount of percolation that would take place through the soil cover. The water balance method is based on the monthly relation between precipitation, evapotranspiration, soil moisture storage, and percolation. This method has been used by the EPA to evaluate cover system designs for solid and hazardous waste sites (EPA/530/SW-168, EPA-600/2-79-165, and EPA/530/SW-867c), and by JBR to evaluate the percolation potential for valley fill Leach 3 at the Mercur Mine (JBR, 1990).

In order to compute the water balance, we have used the following data and assumptions as inputs:

- The average monthly precipitation depths were obtained by reviewing the previous 8 years of monthly data collected at the Mercur Mine. These data were not used directly as inputs in the water balance calculations because they were obtained during dryer than normal years. However, from these data, the percentage of the annual precipitation that occurs in each month was determined. These monthly percentages were then applied to the 16-year (1951-1967) average annual data obtained from the Department of Natural Resources (Hood, et al, 1969). By using the longer period of record, a measure of conservatism was obtained (22 inches per year total for the longer period versus 19 for the previous 8 years).
- We have assumed that all precipitation that occurs goes directly to storage in the soil and that no water is lost to surface runoff. This is conservative in that the reclaimed pad will be graded to provide runoff.
- The potential evapotranspiration was obtained from pan evaporation data collected at the Mercur Mine during 1990. These data were adjusted to evapotranspiration by multiplying by 0.7 (EPA/530/SW-867c).

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- The soil cover was assumed to be 4 feet thick consisting of a clay loam. This soil has available water storage capacity of 3 in/ft. The vegetation was assumed to consist of grasses, shrubs, and forbs which have a root zone depth of 3.33 feet. The total available water which could be stored in the top 3.33 feet of soil cover would be 10 inches. This water would be held in storage and could be removed through evapotranspiration in the upper 3.33 feet of the soil cover.
- A 1-foot thick earthen infiltration barrier exists under the soil cover. The valley fill material is under the infiltration barrier.

Based on these assumption, the water balance evaluation indicates that there would be no percolation of water below the 3.33 foot depth in the soil. A spreadsheet of the monthly water balance is attached as Table 1. In effect, the evapotranspiration that would apply to the top 3.33 feet of soil exceeded the amount of water that percolates into the soil in an average year.

The next step in the evaluation was to re-run the water balance based on the assumption that the vegetation cover might not develop to the full 3.33 foot root zone depth. This would essentially model a poor vegetation cover or immature vegetation. For this evaluation, it was assumed that the root zone depth would only be 1.33 feet (the shallowest root zone depth for which the Thornwaite and Mather model could be applied). Based on a root zone depth of 1.33 feet and a soil water storage capacity of 3 in/ft, the available storage water capacity would only be 4 inches. Table 2 presents the results of the monthly water balance under this scenario.

The results of the poor-vegetation case water balance indicate that there would be 2.29 inches of water annually percolating below the 1.33 ft depth. This amount of water could be held in storage in the soil below the root zone. Based on a water holding capacity of 3 in/ft, the soil would reach field capacity for a depth of 0.76 feet below the 1.33 feet. This water would not be removed by evapotranspiration until the roots penetrated to this depth. Assuming that the root zone stays at 1.33 feet, there would be 2.67 feet of soil cover below this depth that could hold percolation. At a rate of percolation 2.29 inches of water per year, the entire 4-foot thick soil cover would reach field capacity after approximately 3.5 years. After this time, and assuming the cover crop did not recover, the 2.29 inches of water that percolates annually into the soil cover would percolate into the top of the earthen infiltration barrier. However, it is likely that during this time the vegetation would establish deeper roots and thus some of this water in storage would be lost to evapotranspiration.

The final step in the evaluation was to re-run the water balance based on the assumption that the precipitation was double that of normal years. It was assumed that the cover vegetation would be fully developed and have the 3.33 foot root zone. The results of the water balance under this scenario are shown on Table 3 and indicate that there would be 10.78 inches of percolation below the root zone. Because the water storage capacity the soil is 3 in/ft, the 0.67 feet of soil below the root zone would hold 2.01 inches of water, leaving 8.77 inches that would become in contact with the earthen infiltration barrier. Even under a worst case scenario of assuming that the infiltration barrier is not functioning as a permeability barrier, it would still have the capacity to hold 3.6 in/ft of water before it reached field capacity. Thus there would be $8.77 - 3.60 = 5.17$ inches of water that would percolate to the valley fill material. It is unlikely that this amount of water would travel through the valley fill and become in contact with the underlying composite liner.

Based on these monthly water balance evaluations, we conclude that under normal years of precipitation, all precipitation would be stored and lost on an annual basis to evapotranspiration. No water would come in contact with the earthen infiltration barrier, and therefore could not add moisture to the valley fill. Under the scenario of a temporary poor vegetation success, it takes about 3.5 years of this condition before the underlying earthen infiltration barrier would become wet. This condition is also reversible if the deep-rooted vegetation cover is established. Assuming an anomalous condition in which the precipitation is double the average annual, and the earthen infiltration barrier is physically breached by numerous perforations, the amount of percolation that would go through the earthen infiltration barrier would probably not penetrate through the valley fill to the composite liner system underlying Area 2.

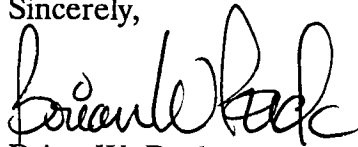
To ensure that the water that would enter the soil cover is only from precipitation, Barrick has committed to control surface runoff above and around the valley fill area in a manner that there will be no run on to the valley fill itself. In addition, Barrick has committed to regrading the reclaimed valley fill surface for drainage and to not use the valley fill area as a storage area for snow during the winter months. These management practices will insure that the water balance evaluated above, is representative of the actual amount of water that would enter the valley fill material.

Further management practices that would be beneficial to providing water storage capacity in the valley fill material itself would be to leave the valley fills uncovered for at least one dry season before placing the earthen infiltration barrier and soil cover. This time between adding the final rinse solutions and reclamation would allow for the water content in the portion of the valley fills to drop below field capacity due to evaporation. In addition, ripping the valley fill surfaces periodically during this drying period would increase the evaporation and thus increase the potential storage.

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If you have any questions regarding this water balance evaluation, feel free to contact myself or Rick Pole.

Sincerely,

A handwritten signature in black ink, appearing to read "Brian W. Buck". The signature is fluid and cursive, with the first name "Brian" being more prominent than the last name "Buck".

Brian W. Buck
Vice President

cc: R. Pole, JBR

Fenn, D. G., Hanley, K. J., and Degeare, T. V., 1975, Use of the Water Balance Method for Predicting Leachate Generation from Solid Waste Disposal Sites. US EPA SW-168

Hood, J. W., Price, D., and Waddell, K. M., 1969, Hydrologic Reconnaissance of Rush Valley, Tooele County, Utah, Utah Technical Publication # 23.

JBR Consultants Group, 1990, Letter Report of Barrick Mercur Gold Mine, Determination of Dump Leach 3 Reclamation Design Percolation Potential.

Lutton, R. J., 1980 Evaluating Cover Systems for Solid and Hazardous Waste, US EPA Municipal Environmental Research Lab. SW-867.

Thornwaite, C. W., and Mather, J. R., 1957, Instructions and Tables for Computing Potential Evapotranspiration and the Water Balance. Centerton, N. J. p 185-311. (Drexel Institute of Technology, Laboratory of Technology, Publications in Climatology, v. 10, no. 3)

TABLE 1

Barrick Mercur
Area 2 Soil Water Balance

Clay Loam with 3.0 inches per foot of water holding capacity
Base Case - Deep Rooted Crops (3.33 ft) - Available Water Capacity = 10 inches

Monthly Water Balance
Thornwaite and Mather Method, 1957
(All numbers in inches)

Month	Precipitation	Potential Evapotrans- piration	P - PE	Sum (-) P-PE	Soil Storage	Change in Soil Storage	Actual Evapotrans- piration	Percolation
Jan	1.64	0.35	1.29		5.27	1.29	0.35	0.00
Feb	2.15	0.35	1.80		7.07	1.80	0.35	0.00
Mar	2.21	1.40	0.81		7.88	0.81	1.40	0.00
Apr	2.04	1.54	0.50	-1.82	8.38	0.50	1.54	0.00
May	2.34	2.45	-0.11	-1.93	8.28	-0.10	2.44	0.00
June	1.36	3.57	-2.21	-4.14	6.64	-1.64	3.00	0.00
July	2.31	9.80	-7.49	-11.63	3.14	-3.50	5.81	0.00
Aug.	1.72	6.65	-4.93	-16.56	1.92	-1.22	2.94	0.00
Sept.	1.60	3.50	-1.90	-18.46	1.58	-0.34	1.94	0.00
Oct	1.86	1.54	0.32		1.91	0.33	1.53	0.00
Nov	1.80	0.35	1.45		3.36	1.45	0.35	0.00
Dec	0.97	0.35	0.62		3.98	0.62	0.35	0.00
Annual	22.00	31.85	-9.85				22.00	

Note that -1.82 inches under Sum (-) P-PE was calculated using the successive approximation method

Barrick Mercur
Area 2 Soil Water Balance

TABLE 2

Clay Loam with 3.0 inches per foot water holding capacity
Shallow Root Zone (1.33 ft) - Available Water Capacity = 4 inches

Monthly Water Balance
Thornwaite and Mather Method, 1957
(All numbers in inches)

Month	Precipitation	Potential Evapotrans- piration	P - PE	Sum (-) P-PE	Soil Storage	Change in Soil Storage	Actual Evapotrans- piration	Percolation
Jan	1.64	0.35	1.29		3.68	1.29	0.35	0.00
Feb	2.15	0.35	1.80		4.00	0.32	0.35	1.48
Mar	2.21	1.40	0.81		4.00	0.00	1.40	0.81
Apr	2.04	1.54	0.50		4.00	0.00	2.04	0.00
May	2.34	2.45	-0.11	-0.11	3.89	-0.11	2.45	0.00
June	1.36	3.57	-2.21	-2.32	2.20	-1.69	3.05	0.00
July	2.31	9.80	-7.49	-9.81	0.33	-1.87	4.18	0.00
Aug.	1.72	6.65	-4.93	-14.74	0.00	-0.33	2.05	0.00
Sept.	1.60	3.50	-1.90	-16.64	0.00	0.00	1.60	0.00
Oct	1.86	1.54	0.32		0.32	0.32	1.54	0.00
Nov	1.80	0.35	1.45		1.77	1.45	0.35	0.00
Dec	0.97	0.35	0.62		2.39	0.62	0.35	0.00
Annual	22.00	31.85	-9.85				19.71	2.29

Barrick Mercur
Area 2 Soil Water Balance

TABLE 3

Clay Loam with 3.0 inches per foot of water holding capacity
Double Precipitation - Deep Rooted Crops (3.33 ft) - Available Water Capacity = 10 inches

Monthly Water Balance
Thornwaite and Mather Method, 1957
(All numbers in inches)

Month	Precipitation	Potential		Sum (-) P-PE	Soil Storage	Change in		Actual	
		P	Evapotrans- piration			Soil Storage	Soil Storage	Evapotrans- piration	Percolation
Jan	3.28	2.93	0.35		10.00	0.00	0.00	0.35	2.93
Feb	4.30	3.95	0.35		10.00	0.00	0.00	0.35	3.95
Mar	4.42	3.02	1.40		10.00	0.00	0.00	1.40	3.02
Apr	4.08	2.54	1.54		10.00	0.00	0.00	4.08	0.00
May	4.68	2.23	2.45		10.00	0.00	0.00	4.68	0.00
June	2.72	-0.85	3.57	-0.85	9.18	-0.82	-0.82	3.54	0.00
July	4.62	-5.18	9.80	-6.03	5.49	-3.69	-3.69	8.31	0.00
Aug.	3.44	-3.21	6.65	-9.24	3.98	-1.51	-1.51	4.95	0.00
Sept.	3.20	-0.30	3.50	-9.54	3.86	-0.12	-0.12	3.32	0.00
Oct	3.72	2.18	1.54		6.04	2.18	2.18	1.54	0.00
Nov	3.60	3.25	0.35		9.29	3.25	3.25	0.35	0.00
Dec	1.94	1.59	0.35		10.00	0.71	0.71	0.35	0.88
Annual	44.00	12.15	31.85					33.22	10.78